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LAKE POYGAN, WINNEBAGO AND WAUSHARA COUNTIES, WISCONSIN

Pacific Northwest Environmental Research Laboratory

Prepared for:

National Environmental Research Center
Wisconsin National Guard
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16. ABSTRACT
Annual total phosphorus and total nitrogen loadings to the lake were estimated and subdivded according to either point or non-point source origin. An assessment of the lake's trophic condition and limiting nutrient is also provided. All data collected by the U.S.E.P.A. National Eutrophication Survey during the one year study of the lake and its tributaries are included in the report.

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REPORT
ON
LAKE POYGAN
WINNEBAGO AND WAUSHARA COUNTIES
WISCONSIN

EPA REGION V

WORKING PAPER No. 45

WITH THE COOPERATION OF THE

WISCONSIN DEPARTMENT OF NATURAL RESOURCES

AND THE

WISCONSIN NATIONAL GUARD

NOVEMBER, 1974

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FOREWORD

The National Eutrophication Survey was initiated in 1972 in response to an Administration commitment to investigate the nationwide threat of accelerated eutrophication to fresh water lakes and reservoirs.

OBJECTIVES

The Survey was designed to develop, in conjunction with state environmental agencies, information on nutrient sources, concentrations, and impact on selected freshwater lakes as a basis for formulating comprehensive and coordinated national, regional, and state management practices relating to point-source discharge reduction and non-point source pollution abatement in lake watersheds.

ANALYTIC APPROACH

The mathematical and statistical procedures selected for the Survey's eutrophication analysis are based on related concepts that:

a. A generalized representation or model relating sources, concentrations, and impacts can be constructed.

b. By applying measurements of relevant parameters associated with lake degradation, the generalized model can be transformed into an operational representation of a lake, its drainage basin, and related nutrients.

c. With such a transformation, an assessment of the potential for eutrophication control can be made.

LAKE ANALYSIS

In this report, the first stage of evaluation of lake and watershed data collected from the study lake and its drainage basin is documented. The report is formatted to provide state environmental agencies with specific information for basin planning [§303(e)], water quality criteria/standards review [§303(c)], clean lakes [§314(a,b)], and water quality monitoring [§106 and §305(b)] activities mandated by the Federal Water Pollution Control Act Amendments of 1972.

Beyond the single lake analysis, broader based correlations between nutrient concentrations (and loading) and trophic condition are being made to advance the rationale and data base for refinement of nutrient water quality criteria for the Nation's fresh water lakes. Likewise, multivariate evaluations for the relationships between land use, nutrient export, and trophic condition, by lake class or use, are being developed to assist in the formulation of planning guidelines and policies by EPA and to augment plans implementation by the states.

ACKNOWLEDGMENT

The staff of the National Eutrophication Survey (Office of Research & Development, U. S. Environmental Protection Agency) expresses sincere appreciation to the Wisconsin Department of Natural Resources for professional involvement and to the Wisconsin National Guard for conduct of the tributary sampling phase of the Survey.

Francis H. Schraufnagel, Acting Assistant Director, and Joseph R. Ball of the Bureau of Water Quality, and Donald R. Winter, Lake Rehabilitation Program, provided invaluable lake documentation and counsel during the Survey. Central Office and District Office personnel of the Department of Natural Resources reviewed the preliminary reports and provided critiques most useful in the preparation of this Working Paper series.

Major General James J. Lison, Jr., the Adjutant General of Wisconsin, and Project Officer CW-4 Donald D. Erickson, who directed the volunteer efforts of the Wisconsin National Guardsmen, are also gratefully acknowledged for their assistance to the Survey.

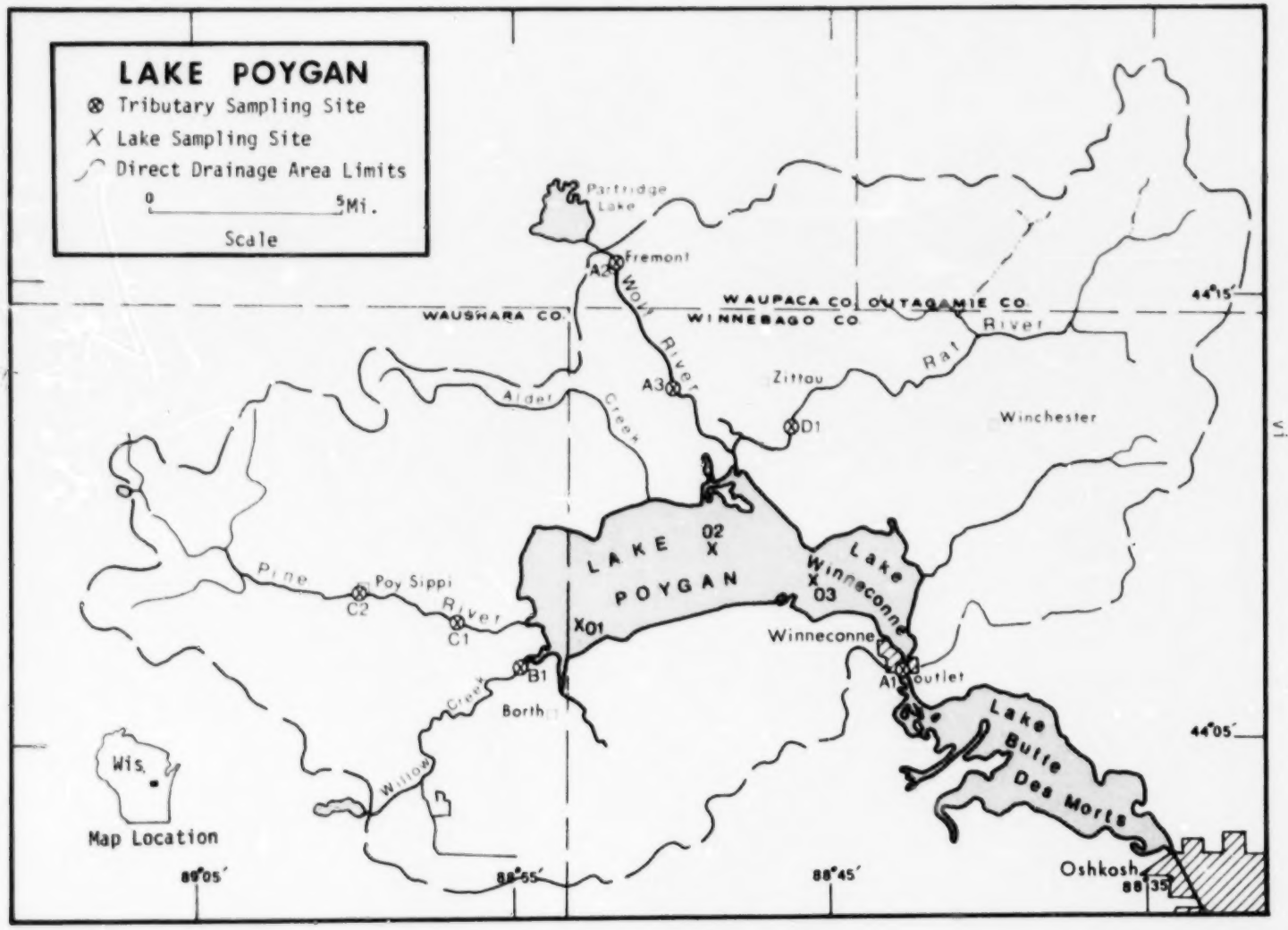
NATIONAL EUTROPHICATION SURVEY

STUDY LAKES

STATE OF WISCONSIN

LAKE NAME	COUNTY
Altoona	Eau Claire
Beaver Dam	Barron
Beaver Dam	Dodge
Big Eau Pleine	Marathon
Browns	Racine
Butte des Morts	Winnebago
Butternut	Price, Ashland
Castle Rock Flowage	Juneau
Como	Walworth
Crystal	Vilas
Delavan	Walworth
Eau Claire	Eau Claire
Geneva	Walworth
Grand	Green Lake
Green	Green Lake
Kegonsa	Dane
Koshkonong	Jefferson, Rock, Dane
Lac La Belle	Waukesha
Middle	Walworth
Nagawicka	Waukesha
Oconomowoc	Waukesha
Okauchee	Waukesha
Petenwell Flowage	Juneau
Pewaukee	Waukesha
Pigeon	Waupaca
Pine	Waukesha
Poygan	Winnebago, Waushara
Rock	Jefferson
Rome Pond	Jefferson, Waukesha
Round	Waupaca
Shawano	Shawano

LAKE NAME	COUNTY
Sinnissippi	Dodge
Swan	Columbia
Tainter	Dunn
Tichigan	Racine
Townline	Oneida
Trout	Vilas
Wapogassett	Polk
Wausau	Marathon
Willow	Oneida
Winnebago	Winnebago, Fond Du Lac, Calumet
Wisconsin	Columbia
Wissota	Chippewa
Yellow	Burnett


LAKE POYGAN
Tributary Sampling Site
Lake Sampling Site
Direct Drainage Area Limits
0
5 Mi.
Scale
Partridge Lake
Fremont
A2
Wolf River
WAUSHARA CO
WAUPACA CO
WINNEBAGO CO
OUTAGAMIE CO
44°15'
Rat River
A3
Zittau
D1
Winchester
Alder Creek
LAKE POYGAN
02
X
Lake Winneconne
X 03
Pine
Poy Sippi
C2
River
C1
X01
Winneconne
B1
A1 Outlet
Borth
Willow Creek
Lake Butte Des Morts
44°05'
Wis.
Map Location
88°05'
88°55'
88°45'
Oshkosh
88°35'

LAKE POYGAN

STORET NO. 5538

I. CONCLUSIONS

A. Trophic Condition:

Survey data indicate Lake Poygan is eutrophic. This lake is listed in "Problem Lakes of the United States" (Ketelle and Uttormark, 1971).

B. Rate-Limiting Nutrient:

Algal assay results indicate Lake Poygan was nitrogen limited at the time the sample was collected. However, a significant loss of nitrogen occurred in the sample, and the results are not considered reliable (see discussion, pages 8 and 9).

C. Nutrient Controllability:

1. Point sources--During the sampling year, Lake Poygan received a phosphorus load at a rate well in excess of that proposed by Vollenweider (in press) as "dangerous"; i.e., a eutrophic rate (see page 14). Of that load, it is estimated that the point sources included within the Survey limit* contributed less than 1%. If only these point sources were considered, it would be concluded that point-source phosphorus control would not significantly improve the trophic condition of Lake Poygan.

* See Working Paper No. 1, "Survey Methods".

However, there are many point sources of phosphorus in the drainage beyond the 25-mile limit of the Survey*, and a more detailed study is needed to assess the effectiveness of phosphorus control in the drainage.

2. Non-point sources (see page 14)--Except for the Pine River, the phosphorus exports of the streams tributary to Lake Poygan were quite high and are indicative of the unmeasured point sources noted above (assuming the export of the Pine River is representative of non-point sources in the Wolf River drainage).

Whether effective control of the phosphorus now reaching Lake Poygan can be achieved is questionable in view of the rather high drainage area to lake area ratio of 226 to 1. With zero point-source contributions, the mean non-point phosphorus export of the tributaries to the lake would have to be reduced to about 37 lbs/mi^2/yr to achieve a loading rate just equal to Vollenweider's eutrophic rate.

* McKersie, et al., 1971.

II. INTRODUCTION

Lake Poygan is the terminus of the Wolf River drainage in northeastern Wisconsin. The entire drainage is in a glaciated part of the State. Land use in the drainage is predominately agricultural, and dairy plants and canneries are common in the southern part of the drainage (McKersie, et al., op. cit.).

The primary uses of Lake Poygan are recreational, including swimming, boating, and fishing. Game fish present are muskellunge, northern pike, walleyes, largemouth bass, and panfish (Anonymous, 1972).

Public access is provided, and commercial facilities offer services.

III. LAKE AND DRAINAGE BASIN CHARACTERISTICS

A. Lake Morphometry†:

1. Surface area: 10,992 acres.
2. Mean depth: 7 feet.
3. Maximum depth: 11 feet.
4. Volume: 76,944 acre/ft.
5. Mean hydraulic retention time: 13 days.

B. Tributary and Outlet:
(See Appendix A for flow data)

1. Tributaries -

Name	Drainage area*	Mean flow*
Wolf River	3,440.0 mi^2	2,599.2 cfs
Willow Creek	114.0 mi^2	91.9 cfs
Pine River	88.4 mi^2	72.5 cfs
Rat River	73.6 mi^2	60.2 cfs
Minor tributaries & immediate drainage -	166.8 mi^2	147.9 cfs
Totals	3,882.8 mi^2	2,971.7 cfs

2. Outlet -

Wolf River	3,900.0 mi^2**	2,971.7 cfs**

C. Precipitation***:

1. Year of sampling: 41.1 inches.
2. Mean annual: 28.4 inches.

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† Ball, 1973.
* Drainage areas are accurate within ±0.5%; mean daily flows are accurate within ±40%; mean monthly flows are accurate within ±35%; and normalized monthly flows are accurate within ±35%.
** Includes area of lake; outflow adjusted to equal sum of inflows.
*** See Working Paper No. 1.

IV. LAKE WATER QUALITY SUMMARY

Lake Poygan was sampled three times during the open-water season of 1972 by means of a pontoon-equipped Huey helicopter. Each time, samples for physical and chemical parameters were collected from three stations on the lake and generally from two depths at each station (see map, page vi). During each visit, a single depth-integrated (near bottom to surface) sample was composited from the stations for phytoplankton identification and enumeration; and during the last visit, a single five-gallon depth-integrated sample was composited for algal assays. Also each time, a depth-integrated sample was collected from each of the stations for chlorophyll a analysis. The maximum depths sampled were 6 feet at station 1, 4 feet at station 2, and 5 feet at station 3.

The results obtained are presented in full in Appendix B, and the data for the fall sampling period, when the lake was essentially well-mixed, are summarized below. Note, however, the Secchi disc summary is based on all values.

For differences in the various parameters at the other sampling times, refer to Appendix B.

A. Physical and chemical characteristics:

Parameter	Minimum	Mean	Median	Maximum
		FALL VALUES (11/08/72)		
Temperature (Cent.)	6.0	6.1	6.2	6.2
Dissolved oxygen (mg/l)	10.4	10.6	10.4	10.9
Conductivity (μmhos)	320	327	325	335
pH (units)	7.7	7.7	7.7	7.7
Alkalinity (mg/l)	135	137	137	139
Total P (mg/l)	0.051	0.068	0.071	0.080
Dissolved P (mg/l)	0.025	0.035	0.041	0.043
NO_2 + NO_3 (mg/l)	0.350	0.412	0.450	0.460
Ammonia (mg/l)	0.060	0.066	0.070	0.070
		ALL VALUES		
Secchi disc (inches)	16	19	18	24

B. Biological characteristics:

1. Phytoplankton -

Sampling Date	Dominant Genera	Number per ml
06/22/72	1. Melosira	3,333
	2. Anabaena	2,536
	3. Cyclotella	2,391
	4. Cryptomonas	1,268
	5. Dinobryon	1,196
	Other genera	1,124
	Total	11,848
08/21/72	1. Anabaena	7,826
	2. Melosira	6,848
	3. Nitzschia	1,014
	4. Fragilaria	870
	5. Cyclotella	399
	Other genera	1,376
	Total	18,333
11/08/72	1. Melosira	1,181
	2. Cyclotella	253
	3. Raphidiopsis	205
	4. Dinobryon	193
	5. Navicula	144
	Other genera	928
	Total	2,904

2. Chlorophyll a -
(Because of instrumentation problems during the 1972 sampling, the following values may be in error by plus or minus 20 percent.)

Sampling Date	Station Number	Chlorophyll a (µg/l)
06/22/72	01	26.1
	02	18.3
	03	14.2
08/21/72	01	27.9
	02	36.3
	03	24.9
11/08/72	01	11.9
	02	5.6
	03	9.7

C. Limiting Nutrient Study:

1. Autoclaved, filtered, and nutrient spiked -

Spike (mg/l)	Ortho P Conc. (mg/l)	Inorganic N Conc. (mg/l)	Maximum yield (mg/l-dry wt.)
Control	0.035	0.390	8.9
0.006 P	0.041	0.390	9.2
0.012 P	0.047	0.390	9.8
0.024 P	0.059	0.390	9.3
0.060 P	0.095	0.390	9.3
0.060 P + 10.0 N	0.095	10.390	44.9
10.0 N	0.035	10.390	13.2

2. Discussion -

The control yield of the assay alga, Selenastrum capricornutum, indicates that the potential primary productivity of Lake Poygan was relatively high at the time the sample was collected. The results also indicate the lake was nitrogen limited. However, there was a significant nitrogen loss

(ca 90 µg/l) in the sample between the time of collection and the time the assay was begun. Had this loss not occurred, it is quite likely the sample would have been phosphorus limited (the lake data indicate a nitrogen/phosphorus ratio of 14/1; i.e., phosphorus limitation would be expected).

The lake data indicate that Lake Poygan was nitrogen limited in June and August. The mean N/P ratios were 8/1 and 5/1, respectively, at those times.

D. Trophic Condition:

Survey data indicate Lake Poygan is eutrophic. Of the 46 Wisconsin lakes studied, 26 had less mean total phosphorus, 20 had less mean inorganic nitrogen, 43 had greater Secchi disc transparency, and 31 had less mean chlorophyll a.

Survey limnologists noted algal blooms in progress in June and in August of 1972.

V. NUTRIENT LOADINGS
(See Appendix C for data)

For the determination of nutrient loadings, the Wisconsin National Guard collected a monthly near-surface grab sample from each of the tributary sites indicated on the map (page vi), except for the high run-off months of April and May when two samples were collected. Sampling was begun in September, 1972, and was completed in August, 1973.

Through an interagency agreement, stream flow estimates for the year of sampling and a "normalized" or average year were provided by the Wisconsin District Office of the U.S. Geological Survey for the tributary sites nearest the lake.

In this report, nutrient loads for sampled tributaries were determined by using a modification of a U.S. Geological Survey computer program for calculating stream loadings*. Nutrient loadings for unsampled "minor tributaries and immediate drainage" ("ZZ" of U.S.G.S.) were calculated using the mean concentrations in the Pine River at station C-2 and the mean ZZ flow.

None of the waste sources listed in the following table were sampled. Loads attributed to the communities are estimates (2.5 lbs P and 9.4 lbs N/capita/year*) and are based on reports of failing septic tank systems. Stream loads do not include community loads.

As far as is known, the dairy plants listed do not contribute nutrients to the drainage.

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* See Working Paper No. 1.

A. Waste Sources:

1. Known community* -

Name	Pop. Served**	Treatment	Mean Flow (mgd)	Receiving Water
Poy Sippi SD	450	Septic tanks	?	Pine River
Fremont	330	Septic tanks	?	Wolf River
Winchester	665	Septic tanks	?	Rat River
N. Lake Poygan SD #1	300	Septic tanks	?	Lake Poygan

2. Industrial* -

Name	Product	Treatment	Mean Flow (mgd)	Receiving Water
Silver-field Cheese Co., Fremont	cheese	land disposal	0.0125*	Wolf River (?)
Daisy Dairy Co., Poy Sippi	cheese	land disposal	?	Pine River (?)

* McKersie, et al., 1971.
** Anonymous, 1971.

B. Annual Total Phosphorus Loading - Average Year:

1. Inputs -

Source	lbs P/ yr	% of total
a. Tributaries (non-point load) -		
Wolf River	484,090	88.9
Willow Creek	15,110	2.8
Pine River	4,950	0.9
Rat River	22,050	4.1
b. Minor tributaries & immediate drainage (non-point load) -	11,940	2.2
c. Known community systems -		
Poy Sippi	1,120	0.2
Fremont	820	0.1
Winchester	1,660	0.3
N. Lake Poygan SD #1	750	0.1
d. Septic tanks* -	170	<0.1
e. Known industrial - None	-	-
f. Direct precipitation** -	1,710	0.3
Total	544,370	100.0

2. Outputs -

Lake outlet - Wolf River (inlet to L. Butte des Morts)	527,330

3. Net annual P accumulation - 17,040 lbs.

* Estimated 270 dwelling on lakeshore; see Working Paper No. 1.
** See Working Paper No. 1.

C. Annual Total Nitrogen Loading - Average Year:

1. Inputs -

Source	lbs N/ yr	% of total
a. Tributaries (non-point load) -		
Wolf River	7,619,760	82.5
Willow Creek	338,350	3.7
Pine River	328,100	3.6
Rat River	245,560	2.7
b. Minor tributaries & immediate drainage (non-point load) -	580,860	6.3
c. Known community systems -		
Poy Sippi SD	4,230	<0.1
Fremont	3,100	<0.1
Winchester	6,250	<0.1
N. Lake Poygan SD #1	2,820	<0.1
d. Septic tanks* -	6,340	0.1
e. Known industrial - None	-	-
f. Direct precipitation** -	105,900	1.1
Total	9,241,270	100.0

2. Outputs -

Lake outlet - Wolf River (inlet to L. Butte des Morts)	9,268,300

3. Net annual N loss - 27,030 lbs.

* Estimated 270 dwellings on lakeshore; see Working Paper No. 1.
** See Working Paper No. 1.

D. Mean Annual Non-point Nutrient Export by Subdrainage Area:

Tributary	lbs P/mi^2/yr	lbs N/mi^2/yr
Wolf River	141	2,215
Willow Creek	133	2,970
Pine River	56	3,712
Rat River	300	3,336

E. Yearly Loading Rates:

In the following table, the existing phosphorus loading rates are compared to those proposed by Vollenweider (in press). Essentially, his "dangerous" rate is the rate at which the receiving waters would become eutrophic or remain eutrophic; his "permissible" rate is that which would result in the receiving water remaining oligotrophic or becoming oligotrophic if morphometry permitted. A mesotrophic rate would be considered one between "dangerous" and "permissible".

	Total Phosphorus		Total Nitrogen	
Units	Total	Accumulated	Total	Accumualted
lbs/acre/yr	49.5	1.6	840.1	loss*
grams/m^2/yr	5.55	0.17	94.2	-

Vollenweider loading rates for phosphorus (g/m^2/yr) based on mean depth and mean hydraulic retention time of Lake Poygan:

"Dangerous" (eutrophic rate)	1.48
"Permissible" (oligotrophic rate)	0.74

* There was an apparent loss of nitrogen during the sampling year. This may have been due to nitrogen fixation in the lake, solubilization of previously sedimented nitrogen, recharge with nitrogen-rich ground water, unknown and unsampled point sources discharging directly to the lake, or underestimation of the nitrogen loads from the point sources. Whatever, the cause, a similar loss has occurred at Shagawa Lake, Minnesota, which has been intensively studied by EPA's National Eutrophication Research and Lake Restoration Branch.

VI. LITERATURE REVIEWED

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VII. APPENDICES

APPENDIX A

TRIBUTARY FLOW DATA

TRIBUTARY FLOW INFORMATION FOR WISCONSIN 9/30/74

LAKE CODE 5538 LAKE POYGAN

TOTAL DRAINAGE AREA OF LAKE 3900.00

TRIBUTARY	SUB-DRAINAGE AREA	NORMALIZED FLOWS JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN
5538A1	3900.00	1600.00	1800.00	3200.00	7100.00	4400.00	3700.00	2100.00	1900.00	2100.00	2220.00	2400.00	2000.00	2875.12
5538A3	3440.00	1400.00	1600.00	3000.00	6200.00	4000.00	3200.00	2100.00	1800.00	2100.00	1900.00	2200.00	1700.00	2599.18
5538B1	114.00	56.00	62.00	180.00	140.00	100.00	90.00	70.00	59.00	67.00	96.00	100.00	81.00	91.91
5538C1	88.40	44.00	48.00	150.00	100.00	78.00	73.00	52.00	46.00	52.00	77.00	83.00	65.00	72.48
5538D1	73.60	37.00	40.00	120.00	85.00	64.00	60.00	43.00	38.00	43.00	66.00	71.00	54.00	60.20
5538ZZ	184.00	89.00	97.00	270.00	240.00	170.00	160.00	110.00	96.00	110.00	150.00	160.00	120.00	147.87

SUMMARY

TOTAL DRAINAGE AREA OF LAKE = 3900.00
SUM OF SUB-DRAINAGE AREAS = 3900.00

TOTAL FLOW IN = 35662.00
TOTAL FLOW OUT = 34520.00

MEAN MONTHLY FLOWS AND DAILY FLOWS

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
5538A1	9	72	3800.00	23	3000.00				
	10	72	5400.00	15	4900.00				
	11	72	4900.00	12	5000.00				
	12	72	3000.00	10	2800.00				
	1	73	3900.00						
	2	73	3100.00	11	4000.00				
	3	73	11000.00	11	14000.00				
	4	73	9700.00	1	9400.00	14	8000.00		
	5	73	11000.00	6	12000.00	20	10000.00		
	6	73	7100.00	26	4400.00				
	7	73	2500.00	14	2300.00				
	8	73	1900.00	11	2100.00				
5538A3	9	72	3000.00	23	2100.00				
	10	72	4600.00	14	4400.00				
	11	72	3700.00	12	4300.00				
	12	72	2400.00	10	2500.00				
	1	73	2900.00						
	2	73	2300.00	11	2500.00				
	3	73	10000.00	11	15800.00				
	4	73	8600.00	1	7200.00	14	7200.00		
	5	73	9900.00	6	1100.00	20	8200.00		
	6	73	6500.00	26	4000.00				
	7	73	2400.00	14	2200.00				
	8	73	1900.00	11	2000.00				

TRIBUTARY FLOW INFORMATION FOR WISCONSIN 9/30/74

LAKE CODE 5538 LAKE POYGAN

MEAN MONTHLY FLOWS AND DAILY FLOWS

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
553881	9	72	96.00	23	68.00				
	10	72	220.00	14	220.00				
	11	72	180.00	12	200.00				
	12	72	110.00	2	110.00				
	1	73	180.00						
	2	73	140.00	4	190.00				
	3	73	670.00	4	120.00				
	4	73	200.00	14	160.00	15	160.00	19	210.00
	5	73	260.00	6	280.00	27	180.00		
	6	73	190.00	30	110.00				
	7	73	76.00	23	57.00				
	8	73	66.00	4	62.00				
5538C1	9	72	74.00	24	52.00				
	10	72	180.00	14	170.00				
	11	72	150.00	12	160.00				
	12	72	88.00	2	88.00				
	1	73	140.00						
	2	73	120.00	4	160.00				
	3	73	540.00	4	99.00				
	4	73	150.00	15	120.00	19	150.00	28	150.00
	5	73	200.00	6	210.00	27	130.00		
	6	73	150.00	30	86.00				
	7	73	58.00	23	44.00				
	8	73	51.00	4	48.00				
5538D1	9	72	62.00	23	44.00				
	10	72	150.00	14	150.00				
	11	72	120.00	12	140.00				
	12	72	75.00	10	78.00				
	1	73	120.00						
	2	73	100.00	11	110.00				
	3	73	460.00	11	660.00				
	4	73	120.00	1	98.00	14	98.00		
	5	73	160.00	6	170.00	27	110.00		
	6	73	120.00	26	78.00				
	7	73	49.00	14	46.00				
	8	73	43.00	11	45.00	0	0.0		
5538Z2	9	72	160.00	23	110.00				
	10	72	340.00	14	330.00				
	11	72	280.00	12	310.00				
	12	72	170.00	10	170.00				
	1	73	260.00						
	2	73	210.00	4	290.00	11	230.00		
	3	73	990.00	4	180.00	11	1400.00		
	4	73	330.00	1	270.00	14	270.00	15	270.00
	5	73	440.00	6	460.00	20	360.00	27	290.00
	6	73	320.00	26	200.00	30	190.00	28	350.00
	7	73	120.00	14	110.00	23	94.00		
	8	73	110.00	4	100.00	11	110.00		

APPENDIX B

PHYSICAL and CHEMICAL DATA

STORET RETRIEVAL DATE 74/09/30

553801
44 07 12.0 088 53 00.0
POYGAN LAKE
55 WISCONSIN

11EPALES 2111202
3 0005 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00630 NO2&NO3 N-TOTAL MG/L	00610 NH3-N TOTAL MG/L	00665 PHOS-TOT MG/L P	00666 PHOS-DIS MG/L P
72/06/22	07 20 0000		18.5	5.8	24	285	7.90	148	0.180	0.100	0.046	0.026
	07 20 0006		18.6	9.6		280	8.10	145	0.180	0.100	0.110	0.027
72/08/21	09 30 0000				19	280	8.65	134	0.060	0.040	0.048	0.018
72/11/08	08 00 0000				16	320	7.70	137	0.350	0.070	0.051	0.026
	08 00 0004		6.0	10.9		320	7.70	135	0.350	0.070	0.063	0.025

DATE FROM TO	TIME OF DAY	DEPTH FEET	32217 CHLRPHYL A UG/L
72/06/22	07 20 0000		26.1J
72/08/21	09 30 0000		27.9J
72/11/08	08 00 0000		11.6J

J VALUE KNOWN TO BE IN ERROR

STORET RETRIEVAL DATE 74/09/30

553802
44 09 24.0 088 49 00.0
POYGAN LAKE
55 WISCONSIN

11EPALES 2111202
3 0006 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00630 NO2&NO3 N-TOTAL MG/L	00610 NH3-N TOTAL MG/L	00665 PHOS-TOT MG/L P	00666 PHOS-DIS MG/L P
72/06/22	08 40	0000	9.4	8.7	18	285	8.30	155	0.220	0.110	0.163	0.050
72/08/21	09 05	0000			17	360	8.60	129	0.070	0.070	0.065	0.026
	09 05	0004	23.7	8.4		358	8.60	130	0.060	0.050	0.075	0.025
72/11/08	07 40	0000			17	325	7.70					
	07 40	0004	6.2	10.4		325	7.70	139	0.460	0.070	0.080	0.043

DATE FROM TO	TIME OF DAY	DEPTH FEET	32217 CHLRPHYL A UG/L
72/06/22	08 40	0000	18.3J
72/08/21	09 05	0000	36.3J
72/11/08	07 40	0000	5.6J

J VALUE KNOWN TO BE IN ERROR

STORET RETRIEVAL DATE 74/09/30

553803
44 08 18.0 088 45 54.0
POYGAN LAKE
55 WISCONSIN

11EPALES
3

2111202
0006 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00630 NO2&NO3 N-TOTAL MG/L	00610 NH3-N TOTAL MG/L	00665 PHOS-TOT MG/L P	00666 PHOS-DIS MG/L P
72/06/22	08 50	0000	18.3	8.8		275	8.40	150	0.080	0.100	0.062	0.024
	08 50	0005	18.3	9.9		270	8.60	149	0.070	0.100	0.088	0.024
72/08/21	08 40	0000			18	270	8.50	130	0.050	0.050	0.077	0.023
	08 40	0004	23.7	7.4		275	8.50	131	0.060	0.070	0.079	0.026
72/11/08	07 20	0000			21	335	7.70	138	0.450	0.060	0.071	0.042
	07 20	0004	6.2	10.4		335	7.70	137	0.450	0.060	0.074	0.041

DATE FROM TO	TIME OF DAY	DEPTH FEET	32217 CHLRPHYL A UG/L
72/06/22	08 50	0000	14.2J
72/08/21	08 40	0000	24.9J
72/11/08	07 20	0000	9.7J

J VALUE KNOWN TO BE IN ERROR

APPENDIX C

TRIBUTARY DATA

STORET RETRIEVAL DATE 74/10/02

553BA2 LS553BA2
44 15 30.0 088 52 00.0
WOLF RIVER
55 15 WEYAUWEGA
T/LAKE POYGAN
US 10 BRDG ABOVE FREMONT STP
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
72/09/23	11 35		0.440	0.850	0.210	0.082	0.096
72/10/14	14 20		0.240	0.900	0.098	0.046	0.096
72/11/12	14 10		0.366	0.750	0.024	0.035	0.061
73/01/13	14 30		0.870	1.100	0.126	0.048	0.080
73/02/11	14 15		0.790	0.880	0.071	0.038	0.070
73/03/11	14 30		0.630	1.470	0.410	0.089	0.188
73/04/01	09 50		0.160	0.660	0.008	0.010	0.035
73/04/14	14 20		0.110	0.780	0.014	0.013	0.030
73/05/06	09 30		0.092	1.380	0.078	0.036	0.060
73/05/20	14 30		0.068	1.540	0.042	0.040	0.080
73/06/26	10 15		0.280	1.470	0.072	0.069	0.120
73/07/14	14 45		0.147	1.150	0.023	0.016	0.095
73/08/11	11 00		0.330	0.840	0.014	0.023	0.090

STORET RETRIEVAL DATE 74/10/02

553BA3 LS553BA3
44 13 00.0 088 55 00.0
WOLF RIVER
55 15 POY SIPPI
T/LAKE POYGAN
BANK ON HWY HH BELO FREMONTSTP
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
72/09/23			0.190	0.650	0.105	0.015	0.105
72/10/14	14 40		0.234	0.950	0.088	0.046	0.096
72/11/12	14 30		0.420	1.050	0.022	0.035	0.061
72/12/10	11 30		1.080	0.600	0.076	0.038	0.063
73/01/07	14 45		0.990	1.050	0.120	0.042	0.070
73/02/11	14 30		0.810	0.900	0.080	0.038	0.070
73/03/11	14 10		0.660	1.500	0.410	0.095	0.290
73/04/01	10 00		0.170	1.760	0.024	0.010	0.040
73/04/14	14 40		0.095	0.640	0.016	0.011	0.030
73/05/06	09 45		0.077	1.200	0.033	0.023	0.055
73/05/20	14 45		0.044	2.000	0.054	0.037	0.075
73/06/26	10 00		0.280	0.780	0.039	0.067	0.100
73/07/14	15 00		0.189	0.810	0.030	0.019	0.105
73/08/11	11 15		0.370	0.690	0.012	0.028	0.095

STORET RETRIEVAL DATE 74/10/03

553881 LS553881
44 06 00.0 088 56 00.0
WILLOW CREEK
55 15 POY SIPPI
T/LAKE POYGAN
CO HWY D BRDG SE OF POY SIPPI
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
72/09/24	16 00		0.056	1.650	0.115	0.089	0.110
72/10/14	10 30		0.500	1.550	0.180	0.046	0.092
72/11/10	13 25		0.480	1.200	0.120	0.035	0.063
72/12/02	10 15		0.820	0.635	0.032	0.014	0.029
73/01/07	09 00		0.880	1.200	0.160	0.022	0.045
73/02/04	14 00		0.770	1.150	0.168	0.025	0.060
73/03/04	11 20		1.260	1.980	0.730	0.075	0.145
73/04/14	08 40		0.150	1.230	0.100	0.040	0.045
73/04/15	12 30		0.168	2.600	0.138	0.018	0.045
73/04/19	15 30		0.035	1.800	0.063	0.018	0.060
73/05/06	08 45		0.050	2.100	0.040	0.030	0.075
73/05/27	13 45		0.048	1.500	0.054	0.038	0.110
73/06/30	11 30		0.078	0.730	0.087	0.082	0.120
73/07/23	13 50		0.037	0.540	0.031	0.033	0.070
73/08/04	08 45		0.030	1.800	0.064	0.026	0.065

STORET RETRIEVAL DATE 74/10/02

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 553AC1          LS553AC1
44 07 30.0 08A 57 30.0
PINE RIVER
55       15 POY SIPPI
T/LAKE POYGAN
N-S RD XING SE OF POY SIPPIBELOW STP
11EPALES              2111204
4                     0000 FEET  DEPTH
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DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
72/09/24	15 10		0.065	1.000	0.140	0.022	0.044
72/10/14	10 00		0.740	0.575	0.066	0.017	0.036
72/11/10	13 00		1.320	1.300	0.065	0.015	0.032
72/12/02	10 30		1.620	0.430	0.025	0.011	0.025
73/01/07	09 15		1.800	0.790	0.072	0.015	0.050
73/02/04	14 30		1.420	0.800	0.084	0.022	0.050
73/03/04	11 30		1.440	1.980	0.380	0.084	0.130
73/04/15	11 55		0.960	1.600	0.091	0.012	0.035
73/04/19	15 10		1.000	1.260	0.031	0.024	0.055
73/04/28	08 15		1.120	2.520	0.100	0.015	0.035
73/05/06	08 10		1.040	1.050	0.042	0.019	0.045
73/06/30	11 10		0.950	0.580	0.040	0.018	0.040
73/07/23	13 25		0.950	0.390	0.046	0.016	0.040
73/09/04	08 30		1.000	1.800	0.160	0.015	0.040

STORET RETRIEVAL DATE 74/10/02

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 553HC2          LS553HC2
44 08 00.0 089 00 00.0
PINE RIVER
55       15 POY SIPPI
T/LAKE POYGAN
ST HWY 49 BRDG ABOV POY SIPPI STP
11EPALES                2111204
4                       0000 FEET  DEPTH
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DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
72/09/24	14 45		0.052	1.050	0.154	0.013	0.037
72/10/14	09 45		0.860	0.550	0.073	0.012	0.037
72/11/10	12 10		1.340	0.610	0.033	0.011	0.030
72/12/02	10 45		1.640	0.560	0.024	0.009	0.022
73/01/07	09 30		1.900	0.720	0.071	0.011	0.030
73/02/04	15 00		1.460	1.600	0.294	0.015	0.035
73/03/04	11 50		1.440	1.320	0.280	0.066	0.110
73/04/15	11 30		1.000	1.500	0.052	0.009	0.030
73/04/19	15 00		1.020	1.400	0.060	0.009	0.040
73/04/28	08 00		1.140	0.980	0.023	0.010	0.020
73/05/06	08 30		1.100	1.050	0.072	0.016	0.040
73/05/27	13 30		0.810	1.300	0.039	0.022	0.055
73/06/30	10 45		1.000	0.630	0.038	0.015	0.040
73/07/23	13 05		1.000	0.490	0.046	0.012	0.040
73/08/04	08 15		1.060	1.980	0.066	0.014	0.055

STORET RETRIEVAL DATE 74/10/02

553801 LS553801
44 12 00.0 088 46 30.0
RAT RIVER
55 15 POY SIPPI
T/LAKE POYGAN
CO HWY MM BRDG S AND E OF ZITTAN
11EPALES 2111204
4 C000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
72/09/23	11 15		0.210	2.300	0.074	0.126	0.154
72/10/14	14 00		0.130	1.750	0.204	0.058	0.088
72/11/12	14 00		0.044	1.600	0.060	0.020	0.046
72/12/10	10 25		0.200	2.100	0.168	0.021	0.063
73/01/13	14 00		0.100	2.600	0.450	0.115	0.300
73/02/11	13 55		0.063		0.110	0.075	
73/03/11	13 45		0.720	1.440	0.220	0.052	0.095
73/04/01	09 30		0.013	1.540	0.034	0.016	0.065
73/04/14	13 55		0.061	1.300	0.022	0.012	0.035
73/05/06	09 15		0.046	1.500	0.028	0.046	0.085
73/05/27	14 15		0.019	1.680	0.029	0.160	0.230
73/06/26	10 30		0.022	2.450	0.080	0.340	0.470
73/07/14	14 30		0.012	2.600	0.046	0.310	0.440
73/08/11	10 35		0.010K	2.200	0.039	0.273	0.370

K VALUE KNOWN TO BE LESS THAN INDICATED